Center Innovation Fund: KSC CIF

Nanocoatings for Wicking of Low-Viscosity Cryogens (CTM)

Completed Technology Project (2013 - 2014)

Project Introduction

The goal of this project is to investigate and develop smart, switchable materials systems for use in thermal management systems, including the evaluation of wicking nanocoatings for use in the transport and storage of cryogens. The project anticipates advancing the state of the art in space propulsion systems by development of the key enabling wicking technology for cryogenic propellant management devices.

Advances continue to be made in areas of novel materials and mechanical refrigeration equipment for the thermal management of cryogens in applications from space transportation to medical imaging. The investigation of novel materials/systems in combination with mechanical refrigeration equipment for use in thermal management systems is the focus of this project. Materials include coatings and other surface finishes while the refrigeration may be active (with cryocoolers), passive (cryogen only), or a combination.

Another important aspect of efficient thermal management is the storage and transport of cryogenic fluids such as liquid hydrogen and liquid helium. These two low-viscosity cryogens are the main challenge and prime target for future applications.

Anticipated Benefits

The advances in cryogenic propellant management technology by use of micro/nano wicking structures proposed in this project may provide a fundamental breakthrough in space propulsion systems. Prototype systems, which are to be developed under this program, will provide game-changing enhanced capability for longer space missions and in management of cryogens in a space environment.

Benefits such as cryogenic propellant refueling depots have been suggested. The utilization of these coatings will greatly reduce chill-down times, life-cycle costs, and system complexity, thereby saving time and reducing costs.

One benefit to the commercial space industry is the quick and safe loading of cryogenic propellant tanks could be enabled by further development and deployment of this technology.

The technology is applicable to energy systems and superconducting power systems of interest to the Department of Energy (DOE) and the Department of Defense (DOD).

Test apparatus for determining cryogenic wicking in nano-coated composite materials

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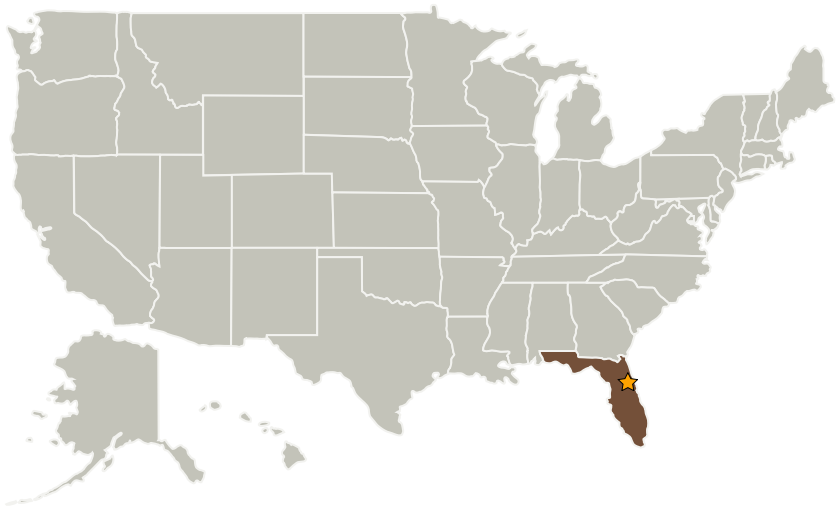
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida

Co-Funding Partners	Type	Location
GE Global Research	Industry	Niskayuna, New York

Primary U.S. Work Locations
Florida

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Center Innovation Fund: KSC CIF

Project Management

Program Director:

Michael R Lapointe

Program Manager:

Barbara L Brown

Project Manager:

Nancy P Zeitlin

Principal Investigator:

Martha K Williams

Co-Investigator:

James E Fesmire

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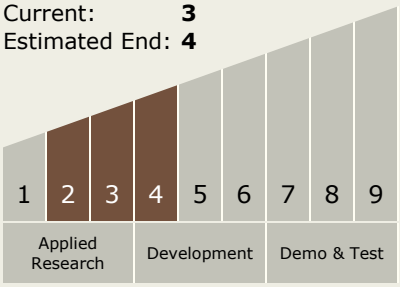
Images

Test apparatus for determining cryogenic wicking in nano-coated composite materials
Test apparatus for determining cryogenic wicking in nano-coated composite materials *(https://techport.nasa.gov/image/2608)*

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **4**



Technology Areas

Primary:

- TX14 Thermal Management Systems
  - TX14.1 Cryogenic Systems
    - TX14.1.1 In-space Propellant Storage & Utilization